Voluntary Remediation Program (VRP) | (307) 777-7752 | http://deq.state.wy.us/volremedi/index.asp

Risk Assessment

In its 2000 session, the Wyoming Legislature created new opportunities, procedures, and standards for voluntary remediation of contaminated sites. These provisions, enacted as Articles 16, 17, and 18 of the Wyoming Environmental Quality Act and implemented by the Wyoming Department of Environmental Quality (DEQ), will govern future environmental cleanups in Wyoming.

This Fact Sheet summarizes DEQ policy on the use of risk assessment in the Voluntary Remediation Program (VRP) and describes guidance that has been developed by DEQ to assist site owners in using risk assessment to make cleanup decisions about their sites.

1. What is the role of risk assessment in the VRP?

The VRP is a risk-based cleanup program. Under the VRP, cleanup levels are developed considering risks to human and ecological receptors and to the environment. Sites are then cleaned to risk-based cleanup levels or to pre-contamination conditions (i.e., natural background), as appropriate. The standards for remedies under the VRP are established at § 35-11-1605 and require that all VRP remedies:

- Protect human health, safety, and the environment.
- Remediate contaminated air, soil, and water to attain applicable standards established under Federal or State law or regulation, or to attain site-specific risk-based cleanup levels developed for the site in question.
- Control any sources of releases so as to reduce or eliminate, to the extent technically practicable, further releases as required to protect human health and the environment.
- Comply with any applicable standard for management of wastes generated as a consequence of the remedy.

Under § 35-11-1605, "protective" remedies are defined as those that reduce risks of acute and chronic toxic exposures to contaminants to levels that do not pose a significant risk to human health, and adequately reduce risks of significant adverse impacts to ecological receptors for which habitats have been identified on or near a site.

2. What are the criteria and requirements for risk-based cleanup levels?

The VRP establishes criteria for risk-based cleanup levels for carcinogens and non-carcinogens.

For carcinogens, the statutory limits under § 35-11-1605(a)(ii)(B) for acceptable carcinogenic risk state that the lifetime excess cancer risk to any exposed individual will not exceed one-in-one million (1×10^{-6}) to one-in-ten-thousand (1×10^{-4}) . Consistent with the statute and EPA guidance, DEQ will

use risk reduction to the one-in-one million level as a point of departure, or target risk level, for remedies when evaluating remedy options. Contaminated sites starting with risk that is within the 1 x 10^{-4} to 1 x 10^{-6} range are not necessarily exempt from remediation. For example, if a site was starting at 1 x 10^{-5} risk for unrestricted site use, an evaluation would be needed to determine the potential for risk reduction to 1 x 10^{-6}. It is DEQ's preference and expectation that cleanups will attain the one-in-one million risk level for all carcinogens.

However, there may be situations where DEQ, in the context of a site-specific evaluation of remedial alternatives and remedy selection, will approve remedies that do not meet the one-in-one-million risk cleanup goal. For example, DEQ might approve a remedy that meets the one-in-one-million risk cleanup goal for the contaminants causing the majority of risk in a given media ("risk drivers"), but does not meet the goal for a limited number of other contaminants. Similarly, in some cases, an evaluation of remedial alternatives in the context of the VRP remedy selection criteria may show that the one-in-one-million risk cleanup goal cannot be met for any carcinogenic contaminants at a site, and therefore, DEQ might approve a remedy that does not meet the one-in-one million risk cleanup goal. Of course, under no circumstance will DEQ accept remedies that do not reduce carcinogenic risk to below the one-in-ten-thousand (1 x 10^{-4}) level.

For contaminants that are systemic toxins, § 35-11-1605(a)(ii)(B) establishes that site-specific risk-based cleanup levels must be established at concentrations that result in a hazard index of one (1) or less. The hazard index is a measure of the non-carcinogenic risks posed by hazardous substances.

When establishing risk-based cleanup levels for both carcinogens and non-carcinogens in soil, DEQ will use unrestricted site use exposure assumptions to a depth of twelve (12) feet (this is the assumed excavation depths for building foundations). Since residential use assumptions typically reflect the most potential exposure at a site, the residential exposure scenario generally represents the greatest potential risk under unrestricted land use conditions.

Non-residential or other restricted site use exposure assumptions may be applied only in situations where (1) a use control area (UCA) has been established by the appropriate local government or DEQ has granted a technical impracticability determination for soils, and (2) DEQ agrees that use of restricted use exposure assumptions is appropriate for the site in question.

When a Volunteer is seeking a UCA designation, a residential exposure scenario needs to be evaluated in addition to exposure scenarios that are currently representative of site conditions or may best represent future site use. Evaluation of a residential exposure scenario is necessary to help the local government make a more informed decision about the need to restrict future site uses. The residential exposure scenario can be developed using the cleanup levels discussed in VRP Fact Sheet #12 *Soil Cleanup Levels*, or by developing appropriate site-specific levels.

In all cases, in addition to considering direct human exposure, DEQ will consider the potential for contamination in soil and groundwater to migrate to other environmental media (surface water, groundwater, or air) and will establish cleanup levels for soil and/or groundwater that prevent unacceptable cross-media transfer.

For screening as part of the soil cleanup levels table, DEQ will use a dilution and attenuation factor (DAF) equal to one (1) when establishing soil cleanup levels to protect groundwater, unless a site-specific approach is used. In this instance, Volunteers are able to account for unsaturated zone attenuation processes (such as deep water table conditions, or soil conditions that adsorb contaminants). In any case, the Volunteer must assume that no reduction of soil leachate concentration occurs from mixing in an aquifer. For more information on calculating site specific soil cleanup levels protective of groundwater, see Fact Sheet #25 *Using Fate and Transport Models to Evaluate Cleanup Levels*.

When assessing risk to groundwater, DEQ will assume that groundwater may be used as a drinking water source, as required under Wyoming law (see § 35-11-1605(a)(ii)(B)). This assumption holds true regardless of whether or not the groundwater is currently being used for drinking. Cleanup levels for naturally occurring hazardous substances (such as metals) will be established in consideration of the background concentration. For more information, refer to Fact Sheet #13 *Groundwater Cleanup Levels*.

When volatile chemicals are present in soil or groundwater in the vicinity of existing or potential future buildings, the Volunteer must evaluate the potential for vapors to migrate into a building (also known as "vapor intrusion"). For more information on evaluation of vapor intrusion refer to Fact Sheet #25 *Using Fate and Transport Models to Evaluate Cleanup Levels*, and EPA (2002b).

When establishing site-specific, risk-based cleanup levels for ecological receptors, DEQ will establish standards that adequately reduce risk of significant adverse impacts to ecological receptors for which habitats have been identified on or near the site.

3. What are DEQ's expectations for remediation of 'source' soils?

If a constituent concentration in site soils exceeds the DAF=1 screening level, the soil may be a potential source of contamination to groundwater. The Volunteer may either 1) accept this conclusion and proceed with remedy evaluation and selection, or 2) choose to refine this preliminary conclusion prior to remedy consideration and selection by establishing site specific screening levels which account for site specific soil conditions and depth to groundwater (for more information see Fact Sheet #25). It is DEQ's general expectation that source soils should be controlled, but the selection of short term or long term remedies, or a combination of both, can be evaluated and proposed by the Volunteer as long as remedial objectives can be achieved.

DEQ has flexibility when selecting remedies to control soil sources of contamination to groundwater. DEQ recognizes that conditions and circumstances at 'more complicated' sites (e.g., complex geohydrology, widespread contamination in soils and groundwater, large suite of potential contaminants) require careful consideration and can present particular challenges when evaluating and selecting remedies to control source soil contamination. Therefore, short-term (more active) or long-term (more passive) remedies, or a combination of the two, may be evaluated and proposed by the Volunteer and selected by DEQ as remedial alternatives for controlling source soils. An example of a condition that may allow for long-term remedies for controlling source soils is: 1) source soils are predicted to impact groundwater, but at concentrations that do not exceed groundwater cleanup standards at an accepted point of compliance; and 2) groundwater and soil contamination is diffuse when compared to other sources of contamination (i.e., presence of non-aqueous phase liquids and

smear zone residual contamination) that have significantly greater impact on groundwater quality at the site. For complicated site conditions, remedial measures may include active treatment or physical removal to control source soils in certain areas, and use of other, less immediate remedial approaches (e.g., monitored natural attenuation) to control source soils at other locations at the site. As part of implementation of a long-term remedy for controlling source soils, DEQ would expect that groundwater use restrictions would be in-place and effective during the remediation period and that source soils meet expected remediation levels at the end of the remediation period.

4. When and how is background contamination considered in establishing site-specific cleanup levels?

The term "background" refers to substances or locations that are not influenced by releases from a site. Once identified and quantified, background concentrations can be used to distinguish site-related contamination from naturally-occurring or pre-existing concentrations of a contaminant. In general, there are two types of background concentrations, naturally-occurring and anthropogenic. In Wyoming, Volunteers will most often need to be concerned about naturally-occurring background concentrations, but there may be situations where anthropogenic concentrations will need to be taken into consideration. In these situations, the Volunteer should consult with DEQ to determine if it is appropriate to consider the contribution of anthropogenic background concentrations.

Naturally-occurring background concentrations are concentrations of hazardous and non-hazardous substances (typically metals) that existed before any waste management or industrial activities at the site and that have not been influenced by humans. Since most organic compounds are typically not naturally occurring, defining naturally occurring background concentrations is generally reserved for metals, such as arsenic and zinc.

Anthropogenic background concentrations are concentrations of hazardous and non-hazardous substances present as a result of human activities. Anthropogenic concentrations generally originate from off-site sources and activities, such as industrial processes, waste disposal, or automobiles. Examples include pesticides and fertilizers, which are commonly found in agricultural areas; hazardous substances (e.g., lead, mercury, nitrogen oxides, organic solvents) from automobile and industrial emissions; and acids and toxic metals from mining activities (e.g., tailing piles or mine waste dumps). The key aspects of anthropogenic concentrations are that they are not specifically related to the activities at the site and they often occur at low concentrations over a wide area.

The determination of background level concentrations can be a complex process. In general, background concentrations are established through the collection and analysis of multiple environmental samples and subsequent statistical evaluation of analytic results. Factors to consider include the following:

- The number of samples must be sufficient to be representative of the study area.
- Defining areas unaffected by site activities is crucial to determining background concentrations. Identifying background sampling locations requires knowing which direction is upgradient, upwind, or upstream.
- Background samples should be collected from each medium of concern in these unaffected areas to determine a valid comparison with site contamination.

- Compositing of samples (i.e., collecting multiple discrete samples within a defined area and combining them into a single sample for purposes of analysis) is not acceptable without prior approval from DEQ. If composite sampling is approved by DEQ, statistical methods for this sampling method must also be approved. Requests for compositing should be included in site characterization work plans and take into consideration the sampling and analytical methods appropriate for the contaminants that may be present, the media being investigated, and the size of the site.

The Role of Naturally-Occurring Background in Risk Assessment

Under § 35-11-1605(a)(ii)(B), cleanup levels will not be established at concentrations lower than naturally occurring background levels. If a risk-based concentration calculated for a contaminant of concern is below that contaminant's natural background level, the cleanup level is adjusted upward to the background level. In contrast, anthropogenic background levels and upgradient sources of contamination do not typically influence the establishment of site-specific cleanup levels, although they may play a role when developing remedial goals, characterizing risks from contaminants that may also be attributed to background sources, and in communicating cumulative risks associated with the site.

Background concentrations of naturally occurring chemicals (metals) can contribute to carcinogenic and noncarcinogenic human health risk. For these chemicals, it is important to be able to distinguish between levels that occur naturally in soil and water (which represent the lower threshold of a cleanup value) and concentrations that are present as a result of contaminant release. For human health risk assessment, DEQ will allow detected concentrations of chemicals that are naturally-occurring to be screened against concentrations representative of background conditions for potential elimination from further consideration in the risk calculations. This step occurs during the process of identifying contaminants of interest for risk evaluation. However, this step may only be employed in cases where the Volunteer has rigorously characterized natural background concentrations. This allowance for screening out background values relatively early in the process of the human health risk assessment is different from the process used in ecological risk evaluation, where all chemicals, regardless of their presence in background, are carried further into the risk evaluation process (see Fact Sheets # 14 and #19 for information on ecological risk assessment).

It may also be prudent for the Volunteer to carry background values through the risk assessment even if good characterization information is available, particularly in cases where detected concentrations are below natural background but above risk based screening concentrations. Volunteers who find themselves in this situation should confer with DEQ about how to best proceed with background values. If the Volunteer does not choose to conduct a rigorous characterization of natural background conditions, DEQ does not allow background to be used as a basis of screening chemicals from further evaluation.

The risk characterization should include a discussion of elevated background concentrations of contaminants of interest and their contribution to site risks. Naturally occurring contaminants that do not exist at a site above background can be screened out from further consideration. This screening does not apply to anthropogenic contaminants unless coordinated with and approved by DEQ prior to the background screening.

DEQ has developed guidance on establishing the naturally occurring background concentrations of metals for Volunteers who wish to consider background concentrations during VRP cleanups. For further information, see Fact Sheet #24 *Establishing Site Specific Background Metals Concentrations in Soil*.

The Difference Between Anthropogenic Background and Off-Site Sources of Contamination

DEQ distinguishes between anthropogenic background (generally low concentrations over a large area) and contamination caused by a release or migration of contaminants from a source not located on the site itself (such as highly contaminated groundwater migrating onto adjacent properties). If a Volunteer believes that off-site sources of contamination may be affecting their site, they may be an innocent owner and should refer to questions 3 and 4 of Fact Sheet #3 *Application for the Voluntary Remediation Program.*

5. When is fate and transport modeling needed and what are the minimum requirements?

Many Volunteers may want to use some form of fate and transport modeling to account for site-specific circumstances when establishing cleanup levels and or during other aspects of risk assessment and remedy selection. DEQ has developed guidance on fate and transport modeling, as described below.

The two main purposes of fate and transport modeling are:

1. Predictive modeling for developing site specific cleanup levels where levels specified in Fact Sheet #12 *Soil Cleanup Levels* are not appropriate to site circumstances. DEQ has developed guidance on such modeling. For further information, please see Fact Sheet #25 *Using Fate and Transport Models to Evaluate Cleanup Levels*.
2. Predictive modeling for risk assessment purposes such as estimating an exposure point concentration for a location where acquiring actual data is infeasible or for a location where there would be considerable variability in the concentration over time. For example, the Johnson and Ettinger Model may be used in certain circumstances to evaluate the potential for vapor intrusion (see Fact Sheet #25 *Using Fate and Transport Models to Evaluate Cleanup Levels*). Guidance on risk assessment modeling in general is also included in Fact Sheet #20.

These guidance documents address specifics of fate and transport modeling in the context of VRP cleanups. Keep in mind that any fate and transport model used to establish site specific cleanup levels must assume that there will be no reduction in soil leachate concentrations from mixing in an aquifer. As addressed in Question 3 above, DEQ has some flexibility when considering soils that are acting as a source of contamination to groundwater. Please refer to Question 3 for considerations and flexibility within DEQ's purview related to fate and transport modeling.

6. What tools and resources are available to guide implementation of risk assessment requirements?

DEQ encourages Volunteers to have frequent communication with DEQ during risk assessment and throughout the entire voluntary remediation process.

Volunteers are also encouraged to consult written guidance. With the help of industry, environmental groups, and other stakeholders, DEQ has developed the following risk assessment guidance documents:

- Fact Sheet #12 *Soil Cleanup Levels*
- Fact Sheet #13 *Groundwater Cleanup Levels*
- Fact Sheet #14 *Ecological Risk Assessment–Steps 1 and 2 Ecological Exclusion and Scoping Assessments*
- Fact Sheet #19 *Ecological Risk Assessment–Steps 3 and 4 Screening and Baseline Ecological Risk Assessment*
- Fact Sheet #20 *Human Health Risk Assessment*

These documents, as well as additional risk assessment guidance, are discussed below.

7. What are the human health and ecological 'stepped' approaches to risk assessment?

All VRP sites are different. Because of this, DEQ believes that site-specific conditions should dictate the level and type of human health and ecological risk assessment carried out. Therefore, DEQ has developed guidance that reflects 'stepped' or 'tiered' approaches to evaluating human health and ecological risk at VRP sites, where the exact risk assessment activities needed are based on site conditions and complexity.

The VRP risk assessment approach consists of two different but related processes; one for human health and the other for ecological receptors.

For human health, the approach is a two-step process. First, Volunteers compare adequate site data to conservative, standardized risk-based screening levels found in Fact Sheet #12 *Soil Cleanup Levels*. The soil cleanup levels table is intended to provide conservative risk-based screening levels for all VRP sites and conservative risk-based cleanup levels for sites that meet all of the following criteria:

- Relatively few contaminants.
- No use control areas.
- Qualification for an ecological risk assessment exclusion based on completion of the VRP preliminary ecological exclusion assessment (Step 1) and/or the ecological scoping assessment (Step 2), as described in Fact Sheet #14 *Ecological Risk Assessment Steps 1 and 2*.

Second, if the site data exceed the screening levels, the Volunteer can choose to use the screening levels as the cleanup levels and begin cleanup immediately, or the Volunteer can conduct a site specific risk assessment to calculate risk under conditions of restricted, current, and likely future land use. The results of the site specific risk assessment would then be compared to the acceptable risk limits established in §35-11-1605(a), as discussed above, to determine whether further cleanup action is necessary.

In most cases, cleanup of soil and groundwater to protect groundwater drinking water resources will also address long term indoor air (vapor intrusion) concerns; however, interim controls, such as building mitigation and/or institutional controls, may be necessary to protect indoor air quality until soil and groundwater remedial standards are met. See Fact Sheet #23 *Institutional Controls, Engineering Controls, and Use Control Areas.*

For ecological risk, DEQ recognizes that not all cleanup sites will present the same types of ecological issues. To accommodate the range of sites that will require consideration in the VRP, DEQ has developed a stepwise approach to ecological risk assessment. Under this approach, all sites first undergo a simple Ecological Exclusion Assessment (Step 1) designed to identify cleanup sites where ecological receptors are unlikely to be affected. If, after the Ecological Exclusion Assessment, a site requires further evaluation, it would then undergo an Ecological Scoping Assessment (Steps 2a and 2b), Ecological Screening Assessment (Step 3), a Baseline Ecological Risk Assessment (Step 4), or some sort of remedial action. Each subsequent step of the ecological risk assessment process is more complex than the previous step. In this manner, some sites may be excluded from the ecological risk assessment process in the early steps, with relatively little effort. If the early steps indicate a need for more complex assessment, then the information already gathered will support and reduce the effort needed for subsequent ecological risk assessment procedures.

§ 35-11-1605 requires that VRP cleanups protect both human health and the environment; therefore, some level of ecological risk assessment will be necessary at all VRP sites, including sites in the Independent Cleanup Process (ICP).

For more complicated sites (e.g., sites with multiple chemicals in soil and groundwater, multiple potential exposure pathways, and where site specific risk assessment is necessary), evaluation of the total site risk may need to include consideration of the risk from all applicable contaminated media and associated pathways. This is the case even where cleanup levels are based on unrestricted site use exposure assumptions. This approach ensures that site-specific cleanup levels will consider the additive health effects from multiple chemicals and determine the potential for additive risk over different media.

DEQ expects that in some circumstances the protection of ecological receptors and groundwater will require lower cleanup levels than would be necessary to protect only human health.

8. How do Volunteers conduct a human health risk assessment?

DEQ recognizes that establishing predictable, efficient procedures for human health risk assessment is critical to implementation of the VRP. As discussed above, DEQ recommends that the first step Volunteers take in human health risk assessment is a comparison of adequate site data to

conservative, standardized risk-based screening levels. Early in the VRP development process, the regulated and environmental communities and other stakeholders requested that DEQ develop a quick screening method for evaluating potential risks to human health at sites with contamination limited to soil. In response to this request, DEQ developed standard risk-based cleanup levels for many constituents in soil. These cleanup levels have been issued in Fact Sheet #12 *Soil Cleanup Levels*. The look-up table provides soil cleanup levels based on direct human contact (dermal, ingestion, and inhalation) and on protection of groundwater. These cleanup levels are based on conservative modeling assumptions and can be used for relatively simple sites with few contaminants.

If contaminants exceed risk-based screening levels based on direct contact, Volunteers have two options. They may choose to use these screening levels as the cleanup levels or they may conduct a site-specific risk assessment. Site-specific risk assessments will calculate risk under conditions of unrestricted, current, and likely future land use. The results of site-specific risk assessments will then be compared to the acceptable risk limits established in § 35-11-1605(a) to determine whether further cleanup action is necessary.

As stated under Question #3 above, in addition to considering direct human exposure for all VRP sites, the potential for contamination to migrate from soil to other media such as surface water, groundwater, and air must be addressed. Cleanup levels will be established to prevent cross-media transfer. In the case of potential groundwater contamination, a dilution and attenuation factor equal to one (1) will be used in the screening level evaluation described in Fact Sheet #12. The Volunteer may be able to establish site-specific fate and transport soil cleanup levels to account for site-specific conditions and circumstances as described in Question #5 above. The Volunteer should discuss the proposed approach with DEQ prior to completing the evaluation.

For more complex sites that can't be readily addressed using the look-up table approach described above, DEQ developed Fact Sheet #20 to guide human health risk assessment. This Fact Sheet specifies methods that should be used in conducting the site-specific human health risk assessment and, as appropriate, references risk assessment methods and guidance developed by EPA. It includes the following information:

1. Requirements for submitting a site-specific risk assessment work plan;
2. Developing a conceptual model for a site and using the conceptual model to plan a site investigation, including data quality objectives to support the risk evaluation;
3. Methods to be used in grouping site data and conducting statistical evaluation to identify representative exposure concentrations;
4. General conditions where contaminant fate and transport modeling would be required and the types of models that should be used (see also Fact Sheet #25 *Using Fate and Transport Models to Evaluate Cleanup Levels*);
5. Exposure equations to use based on unrestricted land use and how use control areas will be used to allow restricted land use;
6. Default equation parameters that should be used, parameters that may be based on site-specific information, and the technical backup information required for their use;
7. Acceptable sources of information on contaminant physical, chemical, and toxicological properties;

8. Uncertainty evaluation;
9. Data presentation and reporting requirements; and
10. Use of site-specific risk assessment results in remedy selection.

For more information on human health risk assessment, refer to Fact Sheet #20.

9. How do Volunteers conduct an ecological risk assessment?

Article 16 of the Wyoming Environmental Quality Act specifies that "...A remedy will be considered protective of the environment if it adequately reduces risk of significant adverse impacts to ecological receptors for which habitats have been identified on or near the site" (§ 35-11-1605(a)(i). All VRP sites *must* be screened to determine if they currently support (or could support) ecological receptors and, if receptors are present, the risks to these receptors must be evaluated.

DEQ has developed a standard process for ecological risk screening that is designed to limit the burden of analysis a Volunteer must conduct. The screening steps and methods are outlined in Fact Sheet #14 *Ecological Risk Assessment–Steps 1 and 2 Ecological Exclusion and Scoping Assessments* and Fact Sheet #19 *Ecological Risk Assessment–Steps 3 and 4 Screening and Baseline Ecological Risk Assessment*. Fact Sheet #19 has two supporting technical memoranda – Steps 3 and 4 – which must be requested from DEQ. The fact sheets (#14 and #19) are available on the DEQ website. DEQ's approach to ecological risk screening has four steps.

In Step 1, a site is evaluated using a simple ecological exclusion assessment checklist designed to determine whether sites can be excluded from further ecological risk evaluation because it is clear that habitats don't exist and ecological receptors are not present. For those sites that are not excluded from assessment during Step 1, Steps 2, 3, 4, or remedial action may be initiated depending on the ecological complexity and concerns at the site.

Steps 2a and 2b, the ecological scoping assessment, are intended to qualitatively determine whether the exposure of ecological receptors to site-related chemicals is likely and if a site must undergo a more complex risk assessment. If important ecological receptors, exposure, or toxicity are shown to be absent during Step 2, then further ecological assessment may not be necessary. Similar to Step 1, for sites that are not excluded from further ecological assessment during Step 2, Steps 3, 4, or remedial action may be initiated depending on the ecological complexity and concerns at the site.

An overview of Steps 3 and 4 is presented in Fact Sheet #19 with the details in the supporting technical memoranda (Tech Memo 3 and Tech Memo 4), which must be requested from DEQ. Step 3 involves a comparison of site-related chemical concentrations to concentrations of contaminants that are considered to be safe for plants, bugs, fish, and wildlife (i.e., an ecological risk-based screening procedure). In this step, contaminant concentrations detected at the site are compared to ecological risk-based screening concentrations (ERBSCs) which are chemical-specific concentrations that represent a threshold above which some measure of ecological effects may occur.

After completion of the three risk-based ecological screening steps (Steps 1, 2a, 2b, and 3), further evaluation of a site with respect to ecological risk may be necessary. In this case, Volunteers would carry out a baseline ecological risk assessment which is referred to as "Step 4" in Fact Sheet #19 *Ecological Risk Assessment–Steps 3 and 4 Screening and Baseline Ecological Risk Assessment*. The details of how to conduct Step 4 are contained in the supporting technical memorandum, which must be requested from DEQ. Ecological risk assessment, Step 4a, involves calculating species-specific risk estimates using readily available exposure and toxicity information, while Step 4b involves collecting additional site-specific exposure or toxicity information that may be submitted separately from, or incorporated into, Step 4a.

The Fact Sheet guidance includes:

1. Requirements for submitting a risk assessment work plan;
2. Problem formulation for a site, including data quality objectives for the risk evaluation;
3. Methods to be used in selecting contaminants of potential ecological concern, grouping site data, and conducting statistical evaluation to identify representative exposure concentrations;
4. Methods to use in selecting the ecological receptors of potential concern and identifying ecosystem components, receptor types, and exposure routes;
5. Methods for evaluating ecological receptor exposure;
6. Methods to present assessment and measurement endpoints;
7. Acceptable sources of information on contaminant toxicological properties and methods for establishing toxicity data to be used in ecological risk assessment;
8. Uncertainty evaluation considerations;
9. Data presentation and reporting requirements; and
10. Approaches for use of ecological risk assessment results in remedy selection.

10. How can I get more information about the VRP?

For more information, to learn about VRP sites in your community, to obtain copies of other VRP Fact Sheets or other guidance documents, or to volunteer for the program, contact DEQ at (307) 777-7752 or through the VRP website at: http://deq.state.wy.us/volremedi/index.asp.

The VRP website includes all of the Fact Sheets and other guidance documents for the VRP. This website is updated frequently and includes the latest information about DEQ=s progress in developing guidance, policy, and other supporting documents for the VRP.

11. References

For additional information regarding background concentrations, the Volunteer is referred to the following documents.

EPA 2002a. *Guidance for Comparing Background and Chemical Concentrations in Soil for CERCLA Sites*. Office of Emergency and Remedial Response, U.S. Environmental Protection Agency. EPA 540-R-01-003. September 2002. Available at: http://www.epa.gov/oswer/riskassessment/pdf/background.pdf

EPA 2002b. *Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils (Subsurface Vapor Intrusion Guidance).* Office of Solid Waste and Emergency Response, U.S. Environmental Protection Agency. (Docket ID No. RCRA-2002-0033 November 2002). Available at: http://www.epa.gov/epawaste/hazard/correctiveaction/eis/vapor.htm